

# **Traffic Study Report**

## **Friday Harbor Ferry Terminal** Master Plan Update

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WASHINGTON STATE FERRIES

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## ***Executive Summary***

The traffic study was conducted as part of the Friday Harbor Ferry Terminal Master Plan Update. After reviewing existing studies and data (as described in the Existing Conditions Report), it was found necessary to design and implement a new comprehensive data collection effort focusing specifically on peak season operations.

The goal of the traffic study was to collect and analyze additional traffic information to complement existing datasets and better understand and evaluate current traffic operations near the ferry terminal during the peak summer season.

The traffic study was conducted over four days (Friday through Monday) on July 21-24, 2006. It included an analysis of ferry unloading/loading performances, and an analysis of the interactions between ferry traffic and local traffic.

The data collection effort and the following data analysis provided key statistics on current traffic operations. It helped identify and quantify specific traffic issues associated with current ferry unloading and loading practices. The specific issues that were identified included:

- Pedestrian/vehicle interactions at the end of the ferry dock blocking unloading traffic;
- Second wave of pedestrian off-loading the boat which added significant delays;
- Heavy left-turns from East to Front Street merging into unloading traffic flow;
- Heavy pedestrian crossings at the bottom of Spring Street;
- Conflicting vehicle movements at Circle Park;
- Pedestrian/vehicle and vehicle/vehicle interactions at the intersection of Spring and First Street;
- Transition between loading from Lot A and loading from Lots B and C;
- Left-turns from First to East Street conflicting with vehicle loading flow.

The identification of these critical issues associated with current ferry operations during the peak season is an early step in the process of developing the potential improvement projects described in the Master Plan Update.

The information collected as part of this traffic study also provides a reference against which future ferry operations and local traffic volumes can be compared.

## **1 Introduction**

A traffic study was performed in July 2006 as part of the Friday Harbor Master Plan Update. The goal of the traffic study was to collect and analyze additional traffic information to complement existing datasets and better understand and evaluate current traffic operations near the ferry terminal during the peak summer season.

Existing datasets were reviewed and documented in the first project deliverable (Existing Conditions Report). Those datasets included traffic counts and ferry ridership statistics for selected periods of 2005. It was found necessary to design and implement a new comprehensive data collection effort focusing specifically on peak season operations.

The traffic study was conducted over four days (Friday through Monday) on July 21-24, 2006. It included two main components:

- **Ferry unloading/loading performance**

The analysis focused on the ferry terminal area. The goal was to measure and characterize actual ferry unloading/loading times and ferry dwell times. Video and traffic counts were collected to allow comparison of events occurring simultaneously at various points. The analysis also identified and quantified issues associated with pedestrian/vehicle interactions and kiss-and-ride operations.

- **Interface with local traffic**

This analysis focused on studying the interface of ferry traffic (loading and unloading) with local traffic. This was done through a series of traffic counts to monitor daily and hourly variations of vehicle volumes. It also included intersection turning movement counts at key intersections during key hours of operations. The goal was to determine the impact of local traffic on ferry unloading/loading operations and dwell times.

The information collected as part of this traffic study provides a reference against which future traffic performances can be compared. Similar data collection techniques and data analysis can be used again in the future to monitor the evolution of traffic conditions and the impact of any improvement projects.

The traffic analysis also highlights critical issues associated with current ferry operations during the peak season, which is a critical step in the process of identifying potential improvement projects.

## **2 Data Collection Program**

The data collection effort involved different methods to gather relevant traffic information.

Tube counts were used to measure hourly (or 15-minute or 5-minute) variations of traffic volumes per direction at specific locations. Tubes were installed at 13 locations around downtown Friday Harbor and the ferry terminal, as shown in Figure 1. Counts were collected all day Friday, Saturday and Sunday.

Intersection turning movement counts provided detailed 15-minute vehicle counts for each movement through the intersection. Pedestrian crossing counts were also collected. Turning

movement counts were collected at three intersections along Spring Street as shown in Figure 2. For the three intersections, counts were collected on Friday from 11:30 AM to 1:30 PM, and on Sunday from 3:30 PM to 5:30 PM.

Video cameras were used to gather additional information including unloading and loading events associated with specific sailings, and to observe detailed operations at strategic locations (vehicle/pedestrian and vehicle/vehicle interactions, intersection performances). Four camera locations were used, as shown in Figure 3. Camera 1 focused on ferry dock operations. Cameras 2 and 3 focused on unloading issues, while Camera 4 focused on loading issues.

In addition to the data collected in Friday Harbor, WSF provided ridership information from Anacortes (vehicle and walk-on counts to Friday Harbor).

The overall data collection program is summarized in Table 1.

**Table 1- July 2006 Data Collection Program**

Type	Locations	Dates
Street Counts (Tubes)	13 locations (see Figure 1)	Friday, Saturday, Sunday
Intersection Turning Movement Counts	3 locations (see Figure 2)	Friday, 11:30 AM to 1:30 PM Sunday, 3:30 PM to 5:30 PM
Cameras	Camera 1: Ferry dock Camera 2: Front/Spring Camera 3: Spring/First Camera 4: First/East (see Figure 3)	Friday, Sunday & Monday Friday & Monday Friday & Monday Sunday

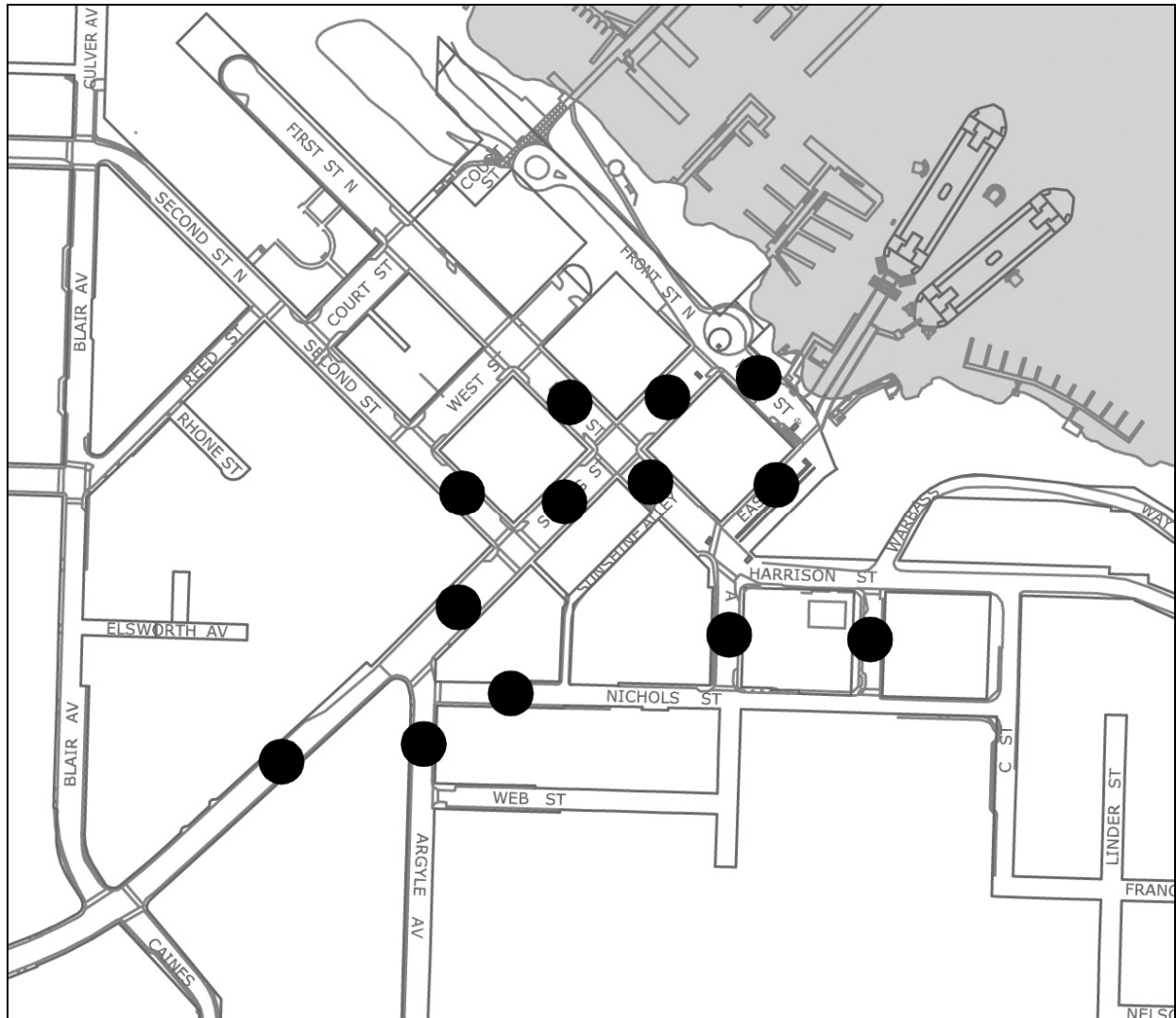


Figure 1- Location of Tube Counts



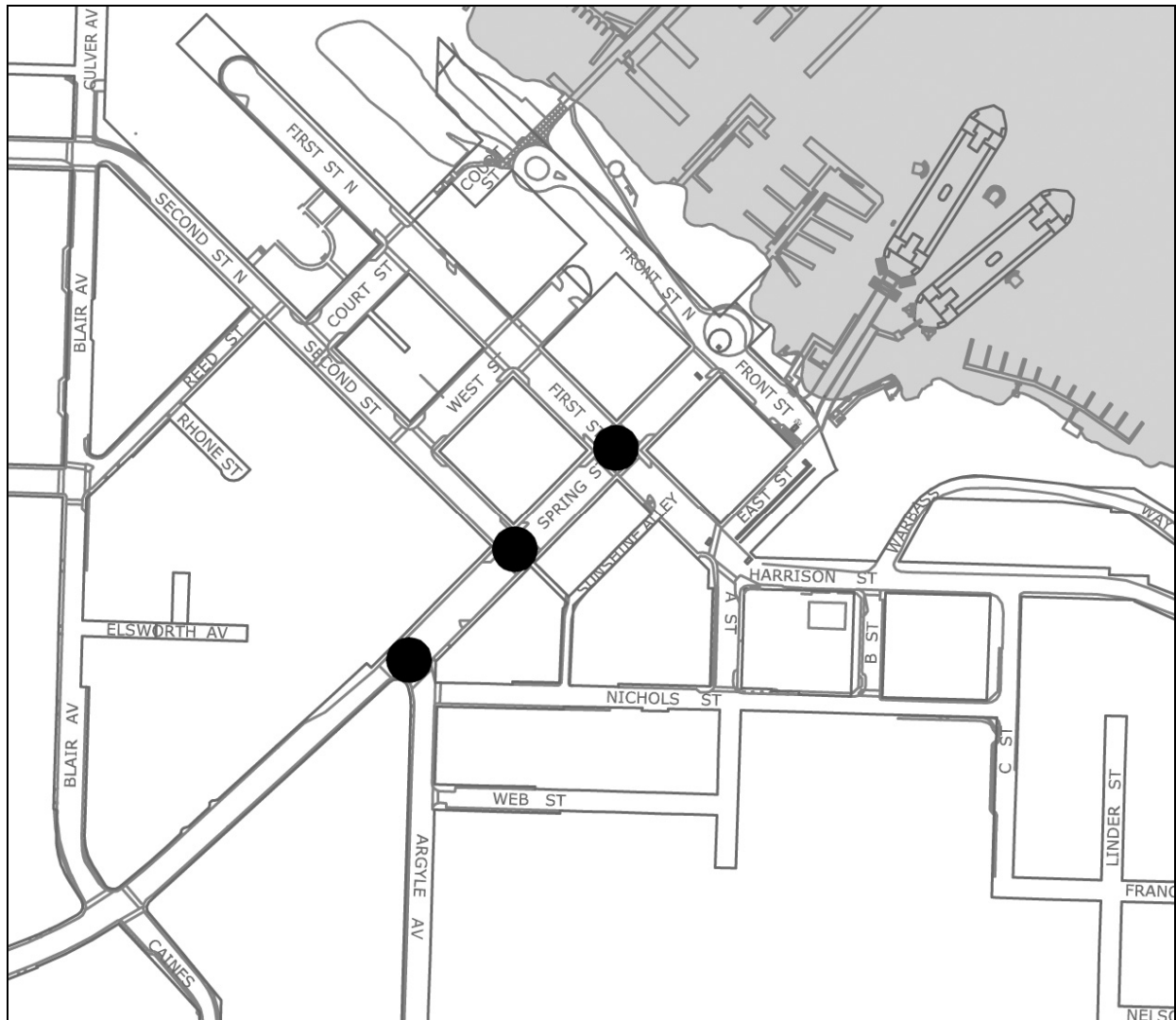


Figure 2- Location of Turning Movement Counts

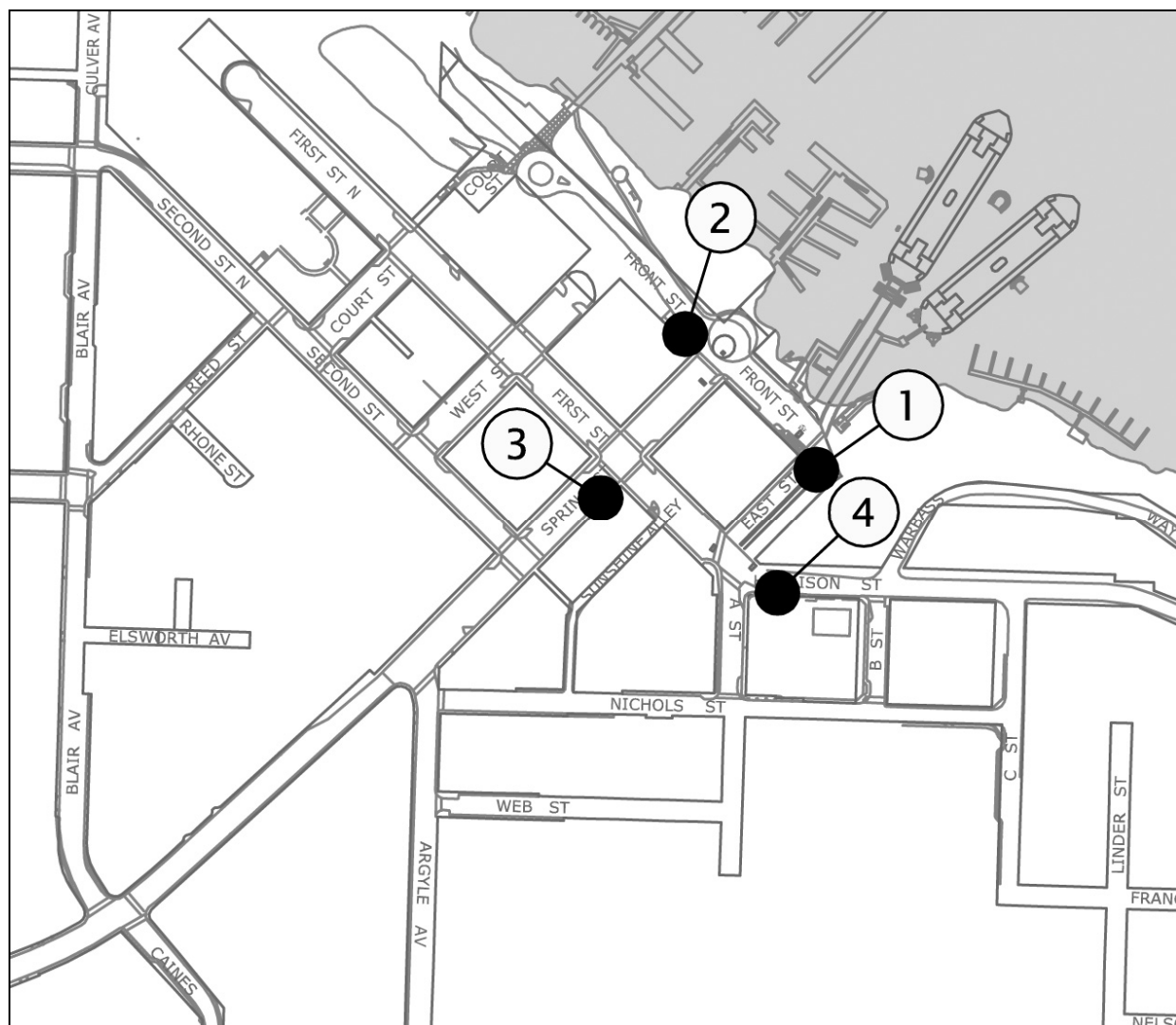


Figure 3- Location of Video Cameras

### 3 Ferry Ridership Statistics

WSF does not collect any ridership statistics in Friday Harbor, with the exception of Sydney-bound travelers. Manual counts (vehicles and walk-ons) were conducted in Anacortes by the Terminal Agent. Ridership reports for the Anacortes-Friday Harbor route are also available through the POS (Point of Sale) reports. Table 2 presents the various counts provided by WSF. The discrepancies between manual vehicle counts and the POS report are probably due the difficulty in trying to load and count cars simultaneously.

**Table 2- WSF Ridership Counts (Anacortes to Friday Harbor)**

Date	Scheduled Arrival in Friday Harbor	Vehicle Hand Counts	Point of Sale Report (vehicles)	Walk-on Hand Counts
<b>Friday, July 21</b>	5:35 AM	39	17	1
	7:35 AM	39	32	22
	9:50 AM	96	94	148
	12:10 PM	155	158	294
	4:15 PM	155	175	168
	6:30 PM	80	75	60
	9:30 PM	129	126	93
<b>Saturday, July 22</b>	2:05 AM	22	19	11
	5:35 AM	16	8	2
	7:35 AM	45	40	10
	9:50 AM	139	136	346
	12:10 PM	118	119	366
	4:15 PM	128	123	181
	6:30 PM	84	80	37
	9:30 PM	66	65	22
<b>Sunday, July 23</b>	2:05 AM	11	11	1
	5:35 AM	5	5	0
	7:35 AM	12	10	4
	9:50 AM	78	70	150
	12:10 PM	109	105	255
	4:15 PM	150	149	118
	6:30 PM	75	70	26
	9:30 PM	100	99	26
<b>Monday, July 24</b>	2:05 AM	14	13	1
	5:35 AM	38	18	0
	7:35 AM	41	37	14
	9:50 AM	84	76	82
	12:10 PM	109	99	253
	4:15 PM	155	153	92
	6:30 PM	75	73	14
	9:30 PM	80	74	19

Over the four days of observations, three arrival sailings carried a full load of vehicles: the Friday 12:10 PM and 4:15 PM arrivals, and the Monday 4:15 PM arrival. The peak sailings for

walk-offs in Friday Harbor were found to be the Saturday 9:50 AM and 12:10 PM arrivals, followed by the Friday 12:10 PM arrival.

## 4 Ferry Operation Performances

### 4.1.1 General information

Tables 3, 4 and 5 summarize key information associated with ferry operations in Friday Harbor, respectively for the Friday, Sunday and Monday study period. Most of the data presented in these tables were gathered through Camera 1 facing the ferry dock.

**Table 3- Ferry Operations Events (Friday)**

<b>FRIDAY 7/21 SCHEDULED ARRIVAL</b>	<b>7:35:00</b>	<b>9:50:00</b>	<b>12:10:00</b>	<b>16:15:00</b>	<b>18:30:00</b>	<b>21:30:00</b>
ACTUAL ARRIVAL TIME	7:40:00	9:49:15	12:21:30	16:26:15	18:43:30	21:40:30
FIRST WALK OFF	7:41:30	9:50:30	12:22:45	16:27:45	18:44:46	21:42:30
LAST WALK OFF	7:43:00	9:53:30	12:32:00	16:36:00	18:46:00	21:45:00
TIME & DURATION OF BARRIER	NONE	9:49-9:55	12:23-12:28:45	16:26:30-16:31:30	NONE	NONE
FIRST VEHICLE OFF	7:43:45	9:53:00	12:26:45	16:30:15	18:45:45	21:43:45
LAST VEHICLE OFF	7:53:00	10:01:45	12:54:45	16:50:30	18:57:00	21:58:30
VEHICLE UNLOADING TIME	0:09:15	0:08:45	0:28:00	0:20:15	0:11:15	0:14:45
VEH UNLOADING RATE (VEH/MIN)	4.2	11.0	5.1	7.2	9.0	8.7
FIRST VEHICLE ON	7:54:30	10:07:15	12:58:30	16:55:45	18:59:00	22:01:00
LAST VEHICLE ON	8:12:15	10:26:30	13:11:00	17:15:30	19:03:45	22:06:00
VEHICLE LOADING TIME	0:17:45	0:19:15	0:12:30	0:19:45	0:04:45	0:05:00
FERRY DEPARTURE TIME	8:17:00	10:28:00	13:13:45	17:19:45	19:06:45	22:07:30
SCHEDULED DEPARTURE TIME	8:10:00	10:25:00	13:00:00	17:00:00	18:55:00	22:00:00
SCHEDULED DWELL TIME	0:35:00	0:35:00	0:50:00	0:45:00	0:25:00	0:30:00
ACTUAL DWELL TIME	0:37:00	0:38:45	0:52:15	0:53:30	0:23:15	0:27:00

**Table 4- Ferry Operations Events (Sunday)**

<b>SUNDAY 7/23 SCHEDULED ARRIVAL</b>	<b>7:35:00</b>	<b>9:50:00</b>	<b>12:10:00</b>	<b>16:15:00</b>	<b>18:30:00</b>	<b>21:30:00</b>
ACTUAL ARRIVAL TIME	7:37:57	10:14:00	12:16:45	16:28:00	18:47:30	21:41:45
FIRST WALK OFF	7:38:40	10:16:00	12:18:15	16:28:45	18:49:30	21:43:15
LAST WALK OFF	7:39:00	10:18:00	12:22:15	16:31:15	18:50:00	21:44:15
TIME & DURATION OF BARRIER	NONE	10:16:15- 10:19:35	NONE	NONE	NONE	NONE
FIRST VEHICLE OFF	7:39:00	10:17:45	12:21:15	16:30:45	18:50:00	21:44:00
LAST VEHICLE OFF	7:40:00	10:24:30	12:38:45	16:51:45	18:57:00	21:53:00
VEHICLE UNLOADING TIME	0:01:00	0:06:45	0:17:30	0:21:00	0:07:00	0:09:00
VEH UNLOADING RATE (VEH/MIN)	12.0	11.6	6.2	7.1	10.7	11.1
FIRST VEHICLE ON	7:55:30	10:29:15	12:45:00	17:00:15	19:01:45	21:55:45
LAST VEHICLE ON	8:05:00	10:45:00	12:56:30	17:20:45	19:11:45	22:00:45
VEHICLE LOADING TIME	0:09:30	0:15:45	0:11:30	0:20:30	0:10:00	0:05:00
FERRY DEPARTURE TIME	8:10:45	10:47:30	13:00:45	17:22:45	19:13:30	22:03:15
SCHEDULED DEPARTURE TIME	8:10:00	10:25:00	13:00:00	17:00:00	18:55:00	22:00:00
SCHEDULED DWELL TIME	0:35:00	0:35:00	0:50:00	0:45:00	0:25:00	0:30:00
ACTUAL DWELL TIME	0:32:48	0:33:30	0:44:05	0:54:45	0:26:00	0:21:30

**Table 5- Ferry Operations Events (Monday)**

<b>MONDAY 7/24 SCHEDULED ARRIVAL</b>	<b>7:35:00</b>	<b>9:50:00</b>	<b>12:10:00</b>
ACTUAL ARRIVAL TIME	7:46:30	9:50:15	12:10:15
FIRST WALK OFF	7:47:30	9:51:15	12:12:00
LAST WALK OFF	7:48:30	9:53:00	12:17:30
TIME & DURATION OF BARRIER	NONE	NONE	12:12:30- 12:18
FIRST VEHICLE OFF	7:48:30	9:53:00	12:17:15
LAST VEHICLE OFF	7:52:30	10:02:00	12:32:30
VEHICLE UNLOADING TIME	0:04:00	0:09:00	0:15:15
VEH UNLOADING RATE (VEH/MIN)	10.3	9.3	6.6
FIRST VEHICLE ON	7:55:00	10:08:30	12:42:30
LAST VEHICLE ON	8:10:00	10:24:45	12:56:00
VEHICLE LOADING TIME	0:15:00	0:16:15	0:13:30
FERRY DEPARTURE TIME	8:15:00	10:27:45	13:00:15
SCHEDULED DEPARTURE TIME	8:10:00	10:25:00	13:00:00
SCHEDULED DWELL TIME	0:35:00	0:35:00	0:50:00
ACTUAL DWELL TIME	0:28:30	0:37:30	0:50:00

#### 4.1.2 Vehicle Unloading Analysis

A detailed analysis of the unloading process was performed for the Friday 12:10 PM and 4:15 PM arrivals. These sailings were selected because they carried a full load of vehicles and exhibited the longest unloading times based on performances reported in Table 3. Unloading patterns of other sailings were studied for comparison purposes. These included the Friday 6:30 PM arrival and the Monday 12:10 PM arrival.

##### 4.1.2.1 Friday 12:10 PM Arrival Unloading Analysis

The pattern of vehicle unloading for the Friday 12:10 PM arrival is shown in Figure 4. The figure shows the cumulative number of vehicles passing through the end of the ferry dock, as gathered through the observation of Camera 1. A total of 144 vehicles (full boat) were counted during the unloading process, which started at 12:26 PM and ended at 12:54 PM. This represents an average unloading rate of 5.1 vehicles per minute.

After the first 5 motorized vehicles, a gap was observed with no vehicles getting through for about 2 minutes. This period corresponds to the unloading of bicycles. The second gap in the unloading process was observed between 12:29 and 12:32. This corresponds to the second wave of walk-offs that was observed on this particular sailing. WSF typically gets the pedestrians off the vessel before the vehicles. But on busy sailings, inevitably, some people

head down to the car deck after the cars have already started off-loading. For safety reasons, WSF staff stop the cars and let the "second wave" get off.

Between 12:32 and 12:36, 38 vehicles were able to turn right onto Front Street, which represents an unloading flow rate of 9.5 vehicles per minute. If this flow rate was maintained throughout the unloading process, the full ferry could be cleared within 15 minutes (as opposed to 28 minutes).

After 12:36 PM, the unloading curve shows a number of other instances where vehicles were blocked, reflecting the impact of vehicle and pedestrian interactions at various locations along the path of unloading vehicles.

The first point of conflict is generated by the flow of local traffic moving along East Street and turning left on Front Street where they merge with the ferry unloading traffic. Figure 5 shows the amount of local traffic making this movement for 5-minute intervals between 12:15 PM and 1:15 PM. During the unloading process (between 12:25 and 1:00), a total of 64 local vehicles were counted making the left-turn movement. When compared to the 144 vehicles exiting the ferry, the left-turns from East Street account for close to a third of the overall traffic volume approaching the traffic circle from Front Street during the unloading period. More information on traffic volumes on East Street is provided in section 5.2.1 of this report.

Another major source of conflict impeding the ferry unloading movement is the amount of pedestrian crossings at the bottom of Spring Street. These interactions were observed on Camera 2. Figure 6 shows the amount of pedestrian crossings on both directions at the crosswalk on the west side of the traffic circle, and the amount of vehicles that made the left-turn movement from Front Street to Spring Street during the same 5-minute interval. There is a clear peak of pedestrian crossings immediately following the ferry arrival: 94 pedestrian crossings were counted between 12:25 and 12:35. There is another peak of pedestrian crossing later (between 12:50 and 12:55) which can be attributed to pedestrians walking towards the ferry terminal for the 13:00 scheduled departure.

Figure 7 provides information about vehicle movements at the traffic circle (Spring and Front) which are in direct conflict with the ferry unloading movement. These various turning movements (U-turns at the circle, movement from the Port to Spring Street and from Spring Street to the Port) can only be served by interrupting the flow of ferry unloading traffic. As shown in Figure 7, there are on average 13 conflicting vehicle movements every 5 minutes throughout the unloading process.

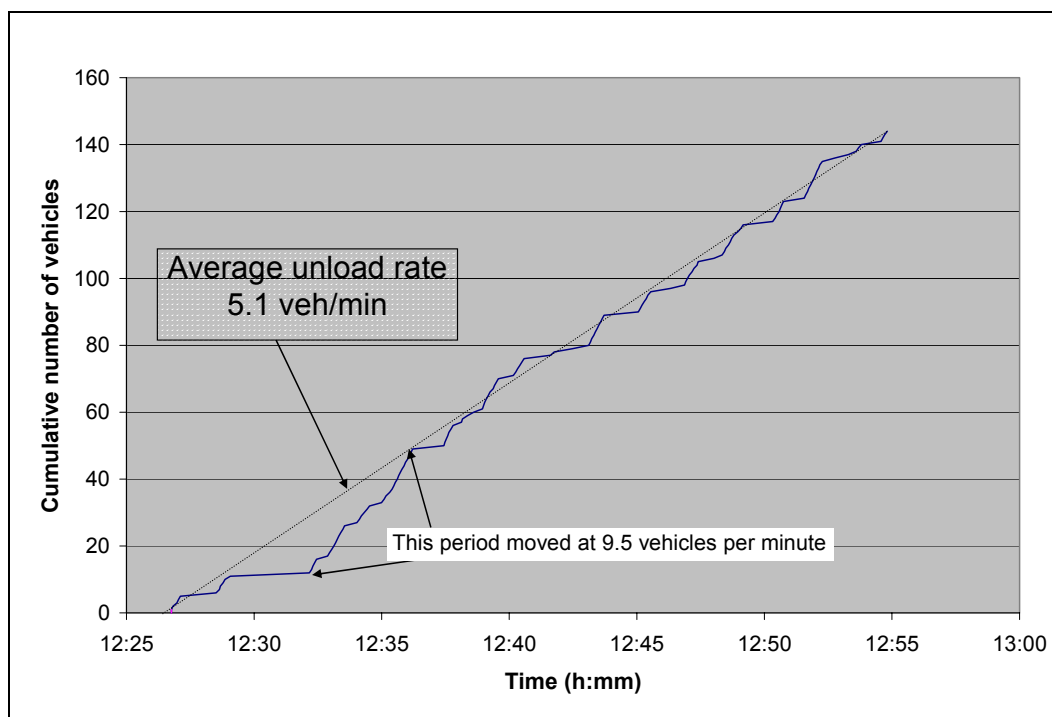


Figure 4- Friday 12:10 PM Arrival Unloading

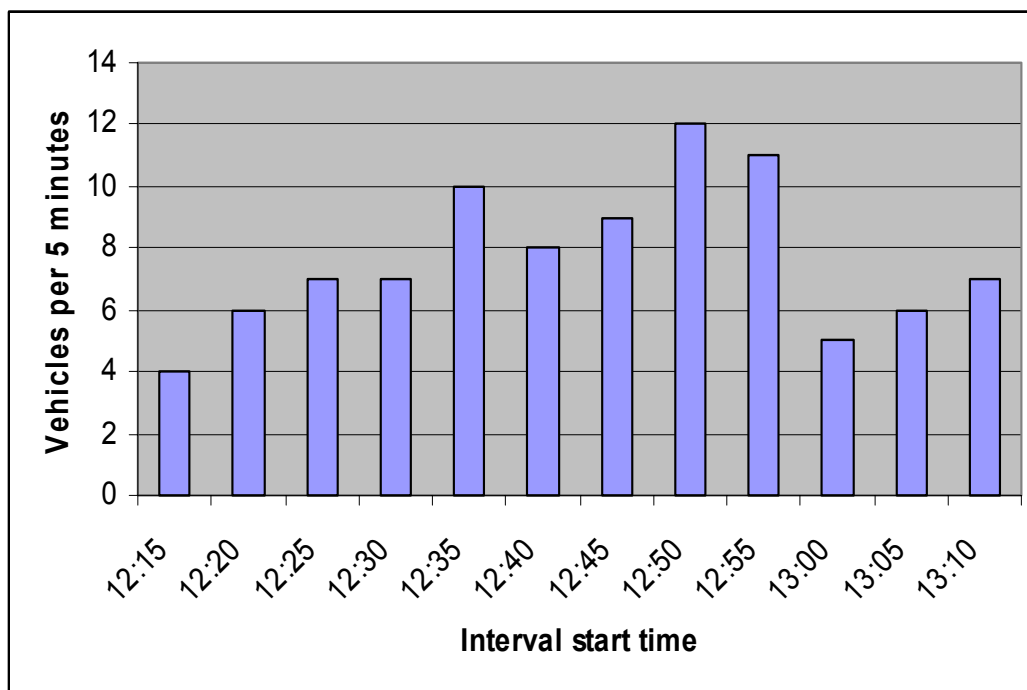


Figure 5- Left-Turn Counts from East St. to Front St.



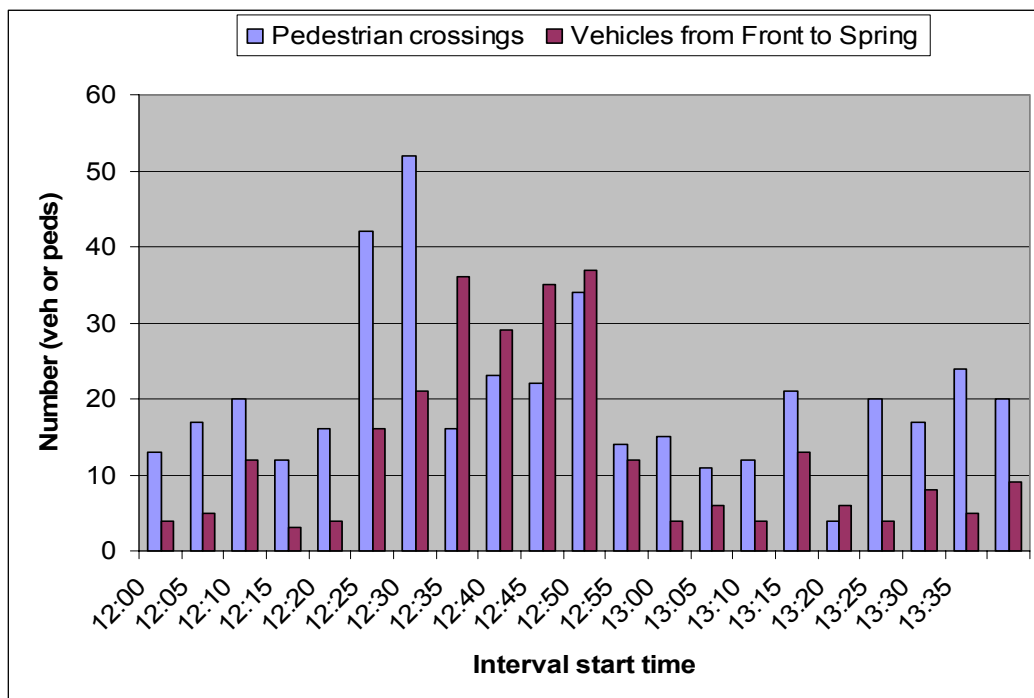


Figure 6- Vehicle/Pedestrian Conflicts at Front St. and Spring St.

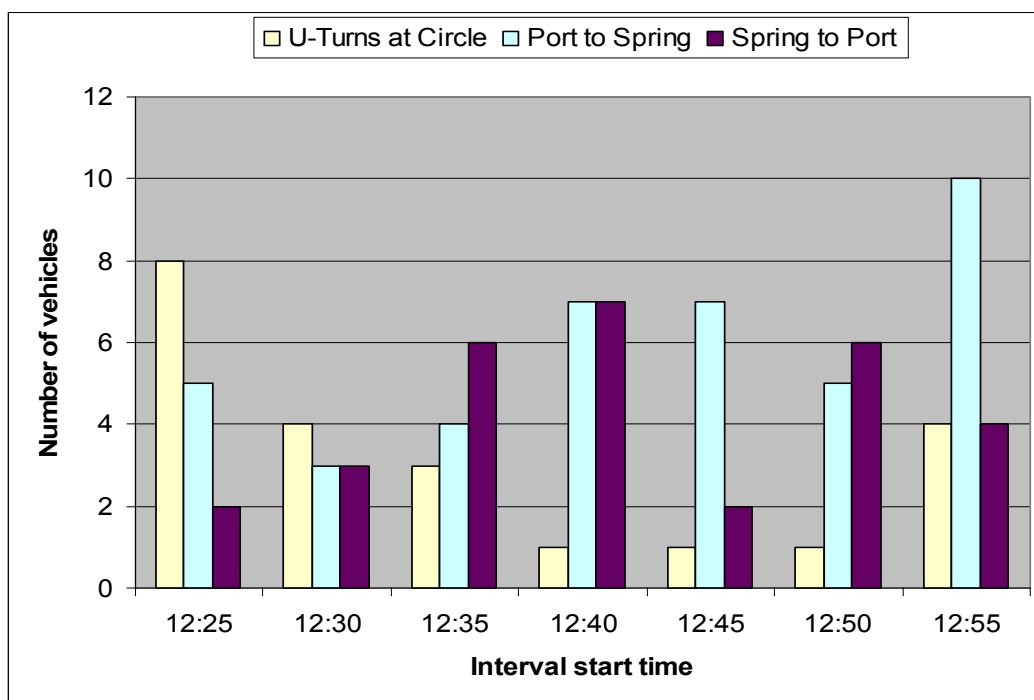
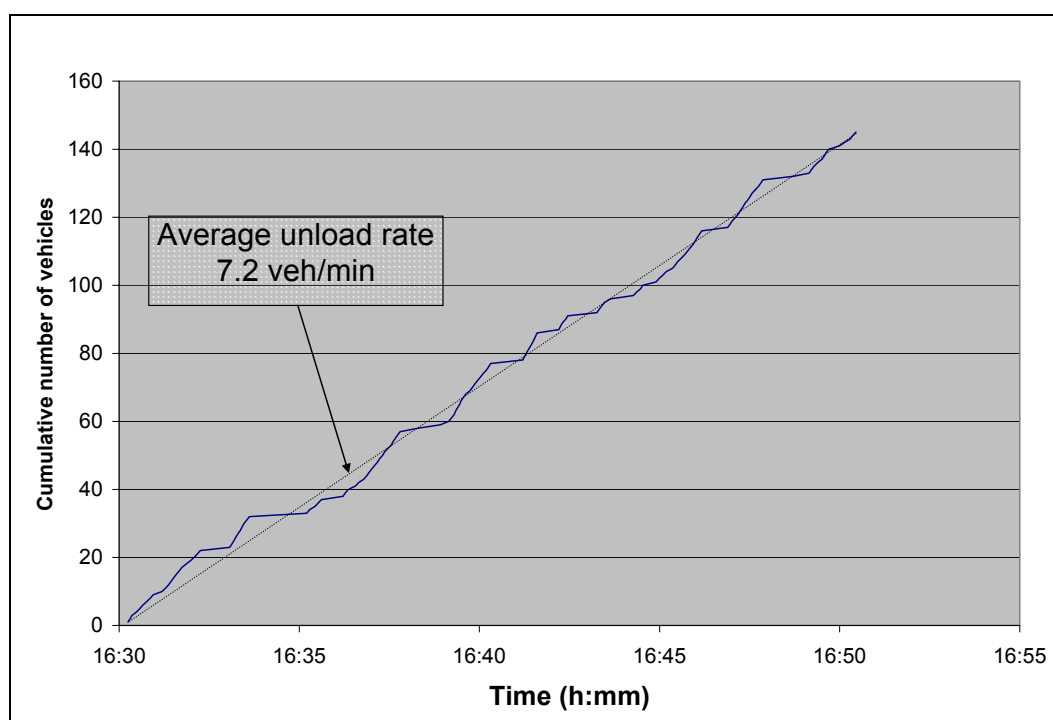


Figure 7- Vehicle Conflicts at Front St. and Spring St.

#### 4.1.2.2 Friday 4:15 PM Arrival Unloading Analysis

The pattern of vehicle unloading for the Friday 4:15 PM arrival is shown in Figure 8. The figure shows the cumulative number of vehicles passing through the end of the ferry dock, as gathered through the observation of Camera 1.

A total of 145 vehicles (full boat) were counted during the unloading process, which started at 4:30 PM and ended at 4:50 PM, which represents an average unloading rate of 7.2 vehicles per minute. The flat segments in the curve from 4:32 to 4:33 and from 4:33 to 4:35 indicate that ferry exiting traffic was blocked during these intervals to allow for left-turns from East Street to Front Street.



**Figure 8- Friday 4:15 PM Arrival Unloading**

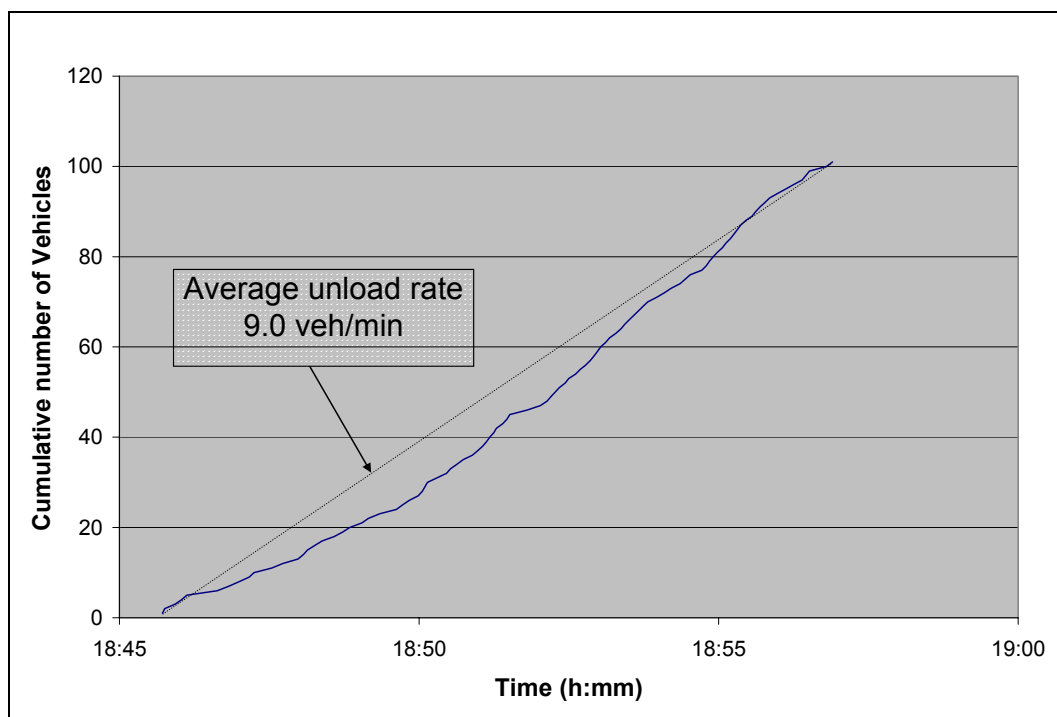
The overall vehicle unloading performance was better than the 12:10 PM arrival for the same number of vehicles (20 minutes instead of 28 minutes). The main reason for this improvement is likely to be the number of walk-offs, which was significantly lower in the 4:15 PM boat. See Table 2 (168 walk-offs compared to 294 walk-offs in the 4:15 PM sailing).

The unloading curve in Figure 8 still shows a number of instances (horizontal portions of unloading “curve”) where unloading traffic was stopped on the ferry dock, due to various vehicle/vehicle and vehicle/pedestrian interactions along Front Street and Spring Street. For instance, the first two flat sections of the curve (at 4:32 and at 4:33) were due to pedestrian crossings at the end of the ferry dock on the north side of Front Street, and traffic director allowing left-turns from East Street to Front Street.

#### 4.1.2.3 Friday 6:30 PM Arrival Unloading Analysis

The pattern of vehicle unloading for the Friday 6:30 PM arrival is shown in Figure 9. The figure shows the cumulative number of offloading vehicles, as gathered through the observation of Camera 1.

A total of 101 vehicles were counted during the unloading process, which started at 6:45 PM and ended at 6:57 PM. This represents an average unloading rate of 9 vehicles per minute.



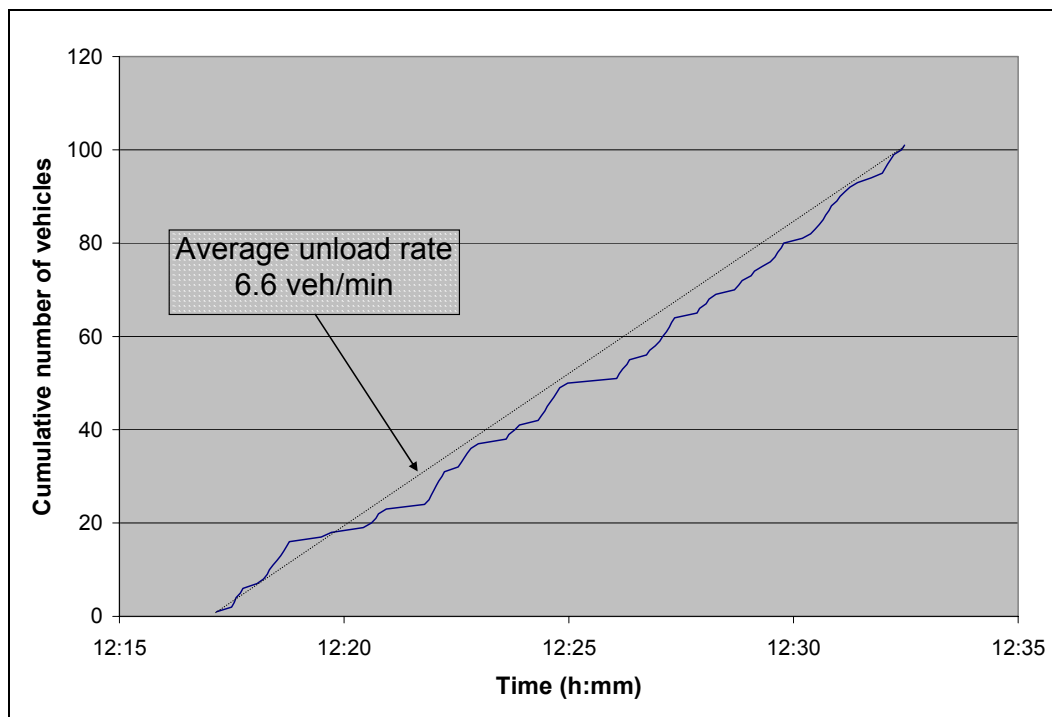
**Figure 9- Friday 6:30 PM Arrival Unloading**

This vehicle unloading pattern reflects very efficient operations. Unloading vehicles were allowed to smoothly flow through the ferry dock and proceed onto Front Street. This is due to a combination of factors including less vehicular and pedestrian traffic from the ferry, and less local traffic through downtown.

#### 4.1.2.4 Monday 12:10 PM Arrival Unloading Analysis

The pattern of vehicle unloading for the Monday 12:10 PM arrival is shown in Figure 10. The figure shows the cumulative number of vehicles passing through the end of the ferry dock, as gathered through the observation of Camera 1.

A total of 101 vehicles were counted during the unloading process, which started at 12:17 PM and ended at 12:32 PM. This represents an average unloading rate of 6.6 vehicles per minute.



**Figure 10- Monday 12:10 PM Arrival Unloading**

The large number of walk-offs (253) certainly contributed to overall poor performance, especially during the first part of the vehicle unloading process. A number of large trucks were traveling on this boat, which also slowed down the early part of unloading (between 12:19 and 12:21). Another factor is local traffic coming down East Street which is typically higher during lunch hours on weekdays. More information on traffic volumes on East Street is provided in section 5.2.1.

#### 4.1.3 Vehicle Loading Analysis

A detailed analysis of the loading process was performed for the Sunday 1:00 PM, 5:00 PM and 6:55 PM departures based on camera observations. These sailings were selected because the Existing Conditions Report indicated they would carry the heaviest loads of vehicles leaving the island.

#### 4.1.3.1 Sunday 1:00 PM Departure Loading Analysis

The pattern of vehicle loading for the Sunday 1:00 PM departure is shown in Figure 11. The figure shows the cumulative number of vehicles passing through the beginning of the ferry dock, as gathered through the observation of Camera 1.

A total of 141 vehicles were counted during the loading process, which started at 12:45 PM and ended at 12:56 PM. This represents an average loading rate of 12.2 vehicles per minute.

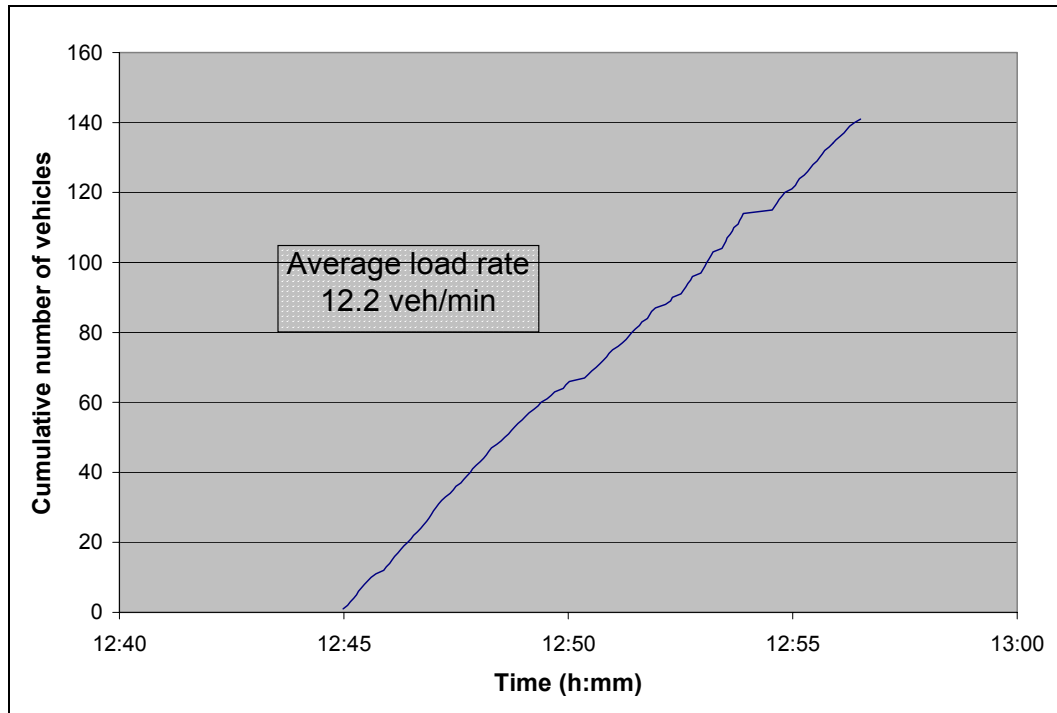


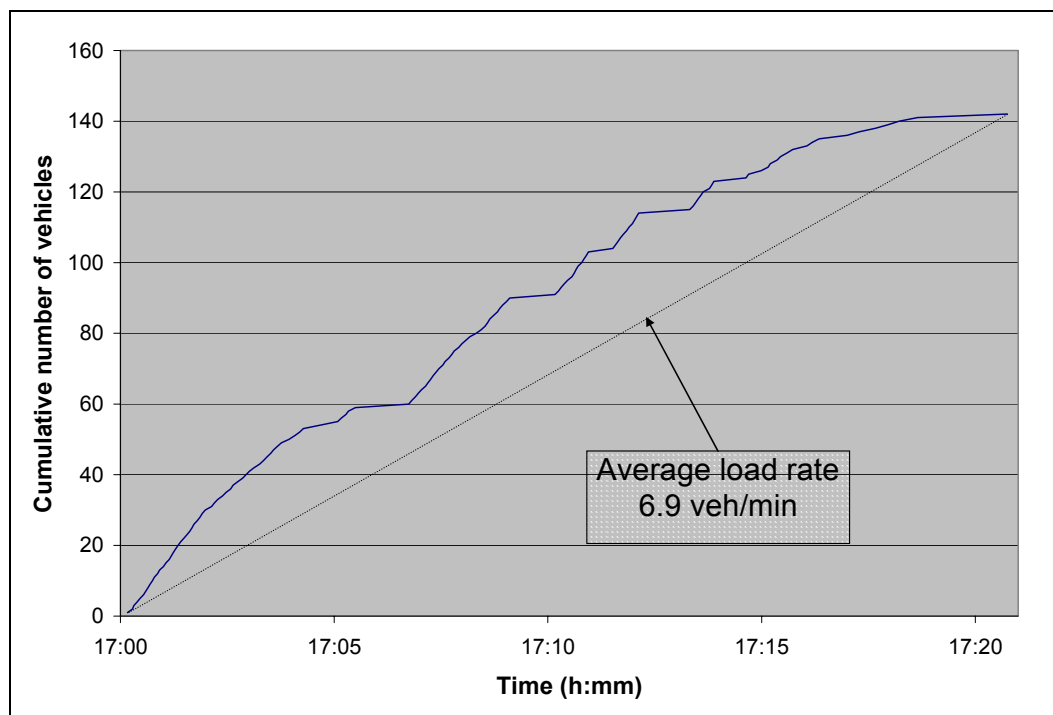
Figure 11- Sunday 1:00 PM Departure Loading

The loading process for this sailing was very efficient and reflects ideal operations for single lane loading. The transition between the end of Lot A loading and the beginning of loading from A Street of vehicles from Lots B and C occurred at 12:50:30 and did not create any disruption in the loading flow.

#### 4.1.3.2 Sunday 5:00 PM Departure Loading Analysis

The pattern of vehicle loading for the Sunday 5:00 PM departure is shown in Figure 12. The figure shows the cumulative number of vehicles passing through the beginning of the ferry dock, as gathered through the observation of Camera 1.

A total of 142 vehicles were counted during the loading process, which started at 5:00 PM and ended at 5:21 PM. This represents an average loading rate of 6.9 vehicles per minute.



**Figure 12- Sunday 5:00 PM Departure Loading**

This curves shows that various disruptions occurred throughout the loading process. The observation of video data from Cameras 1 and 4 provided information on the sources of these disruptions.

The first gap in the loading process (approximately from 5:04 PM to 5:07 PM) was due to vehicles stopped while boarding the ferry and queuing on the dock.

The second gap (approximately from 5:09 to 5:10) occurred during the transition from the end of the Lot A loading and the beginning of loading from A Street of vehicles from Lots B and C.

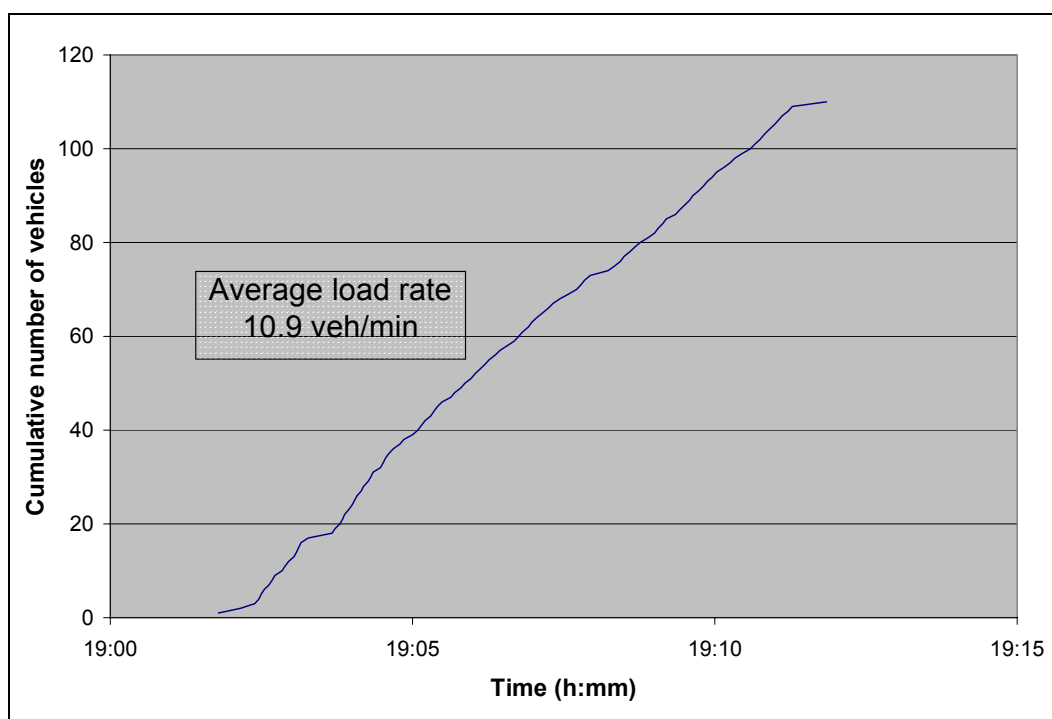
Three additional shorter gaps were observed between 5:10 and 5:15 PM. These gaps in vehicle loadings corresponded to periods when conflicting movements were served at the intersection of First and East, which blocked the flow of traffic going down East Street. This indicates a need to allow vehicles coming from First Street to proceed through the intersection

at East Street in order to prevent the queue from spilling back onto the intersection of First and Spring Street.

#### 4.1.3.3 Sunday 6:55 PM Departure Loading Analysis

The pattern of vehicle loading for the Sunday 6:55 PM departure is shown in Figure 13. The figure shows the cumulative number of vehicles passing through the beginning of the ferry dock, as gathered through the observation of Camera 1.

A total of 110 vehicles were counted during the loading process, which started at 7:02 PM and ended at 7:12 PM. This represents an average loading rate of 10.9 vehicles per minute.



**Figure 13- Sunday 6:55 PM Departure Loading**

The loading process was generally smooth with only minor disruptions. The loading started from A Street. The slight gap experienced at 7:03 PM was due to traffic control at First and East, with some vehicles allowed to make a left turn down on East Street.

## 5 Interface with Local Traffic

### 5.1 Intersection Analysis

#### 5.1.1 Intersection of Spring Street and First Street

Turning movement counts were collected at the intersection of Spring Street and First Street on Friday July 21 from 11:30 AM to 1:30 PM and on Sunday, July 23 from 3:30 PM to 5:30 PM. Manual traffic control was implemented at that intersection for all boats arriving from Anacortes during these time periods (including the 4:15PM arrival).

##### 5.1.1.1 Friday Analysis

Figure 14 provides the turning movement counts for the peak hour on Friday (12 to 1:00 PM).

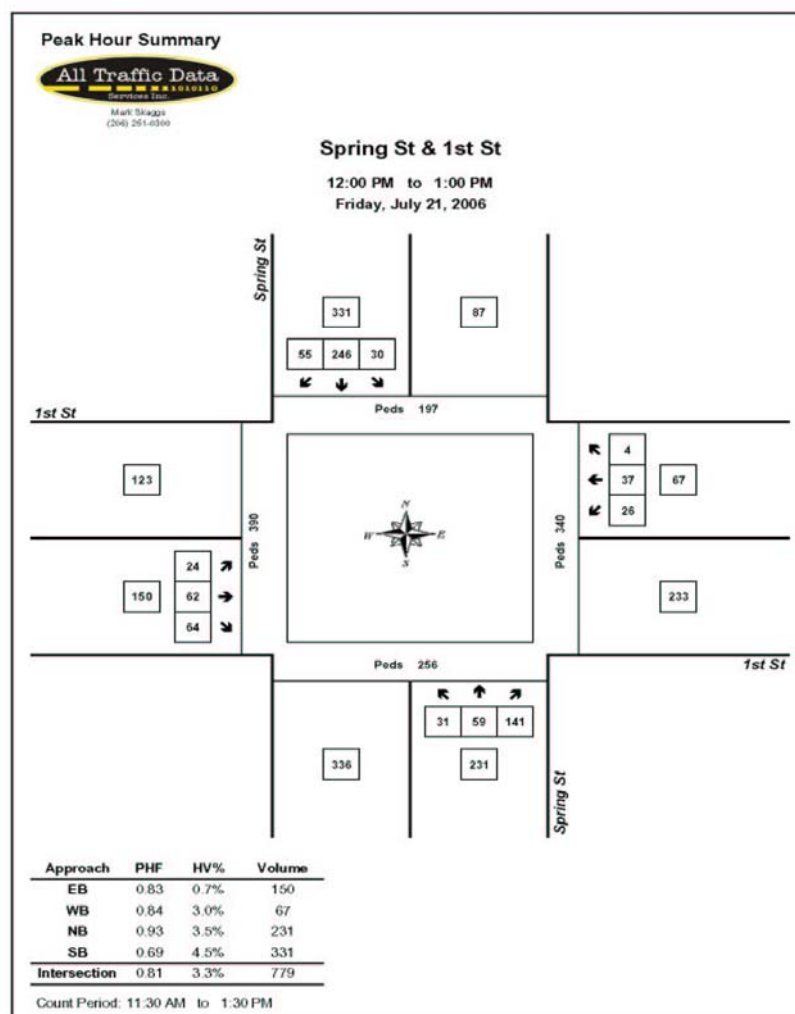


Figure 14- Spring/First Turning Movements (Friday 12 to 1PM)



During the peak hour, the heaviest traffic volumes were observed on the southbound approach, with a total of 331 vehicles approaching the intersection. The northbound approach carried 231 vehicles, with a high proportion of right-turns onto First Street towards the ferry terminal (141 vehicles or 61%).

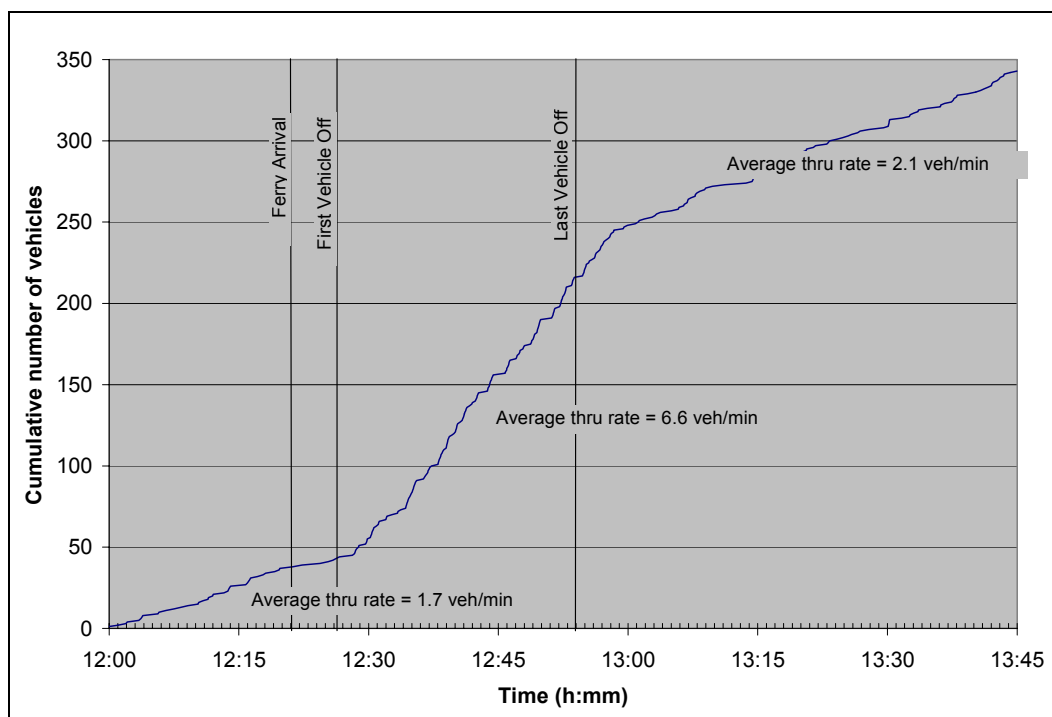
Pedestrian crossings were higher across First Street than across Spring Street. Across First Street, pedestrian crossings were higher on the west side of the intersection (390 crossings versus 340 on the east side). Across Spring Street, pedestrian crossings were higher on the south side of the intersection (256 crossings versus 197 on the north side).

The southbound movement counts on Spring Street include the ferry unloading traffic, which affected the intersection between 12:30 PM and 1:00 PM. Between 12:30 PM and 1:00 PM, 239 vehicles were counted on the north leg of the intersection (coming from the traffic circle). A total of 192 vehicles (or 80%) continued through on Spring Street, while 36 vehicles (15%) turned right and 11 vehicles (5%) turned left.

Conflicting movements for ferry traffic unloading include pedestrians crossing Spring Street, northbound left-turns on Spring Street, eastbound traffic on First Street, and westbound through and left-turn movements on First Street. Between 12:30 PM and 1:00 PM, counts on the conflicting movements were as follows:

- 107 pedestrian crossings on the north side of the intersection;
- 120 pedestrian crossings on the south side of the intersection;
- 11 vehicles turning left on Spring Street northbound;
- 71 vehicles on First Street eastbound;
- 37 vehicles going through or turning left on First Street westbound

During the unloading process, the intersection was able to serve on average 6.6 vehicles per minute on the southbound movement, as illustrated on Figure 15. Before and after the ferry unloading, the intersection typically serves a lower demand on the southbound movement, around 2 vehicles per minute.

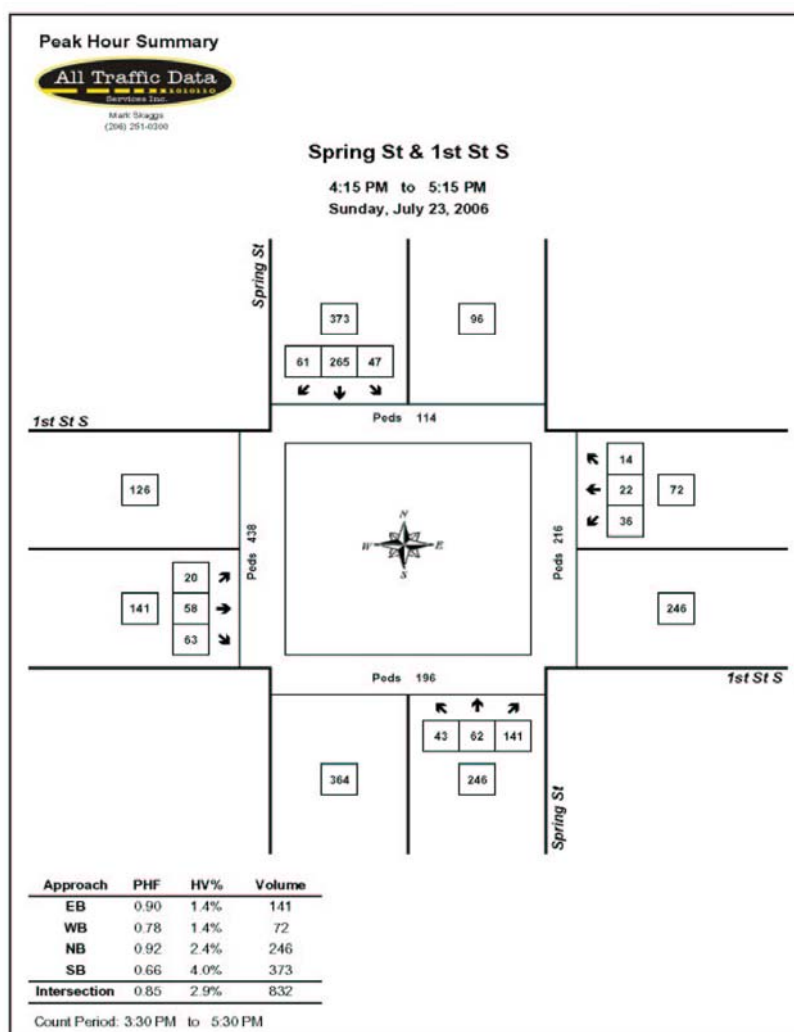


**Figure 15- Flow Rates on Southbound Spring St. across First St.**

#### 5.1.1.2 Sunday Analysis

Figure 16 provides the turning movement counts for the peak hour on Sunday (4:15 PM to 5:15 PM). This period captures the ferry arrival with vehicle unloading from 4:31 PM to 4:52 PM and the ferry departure with vehicle loadings from 5:00 PM to 5:20 PM.

Hourly turning movement counts are very similar to those recorded on Friday between 12PM and 1PM. The ferry unloading movement still dominates. The loading movement (right-turns from northbound Spring onto First Street) does not show any peaks. Fifteen-minute right-turn volumes are consistent (between 30 and 40 vehicles) during the entire study period (from 3:30 PM to 5:30 PM).

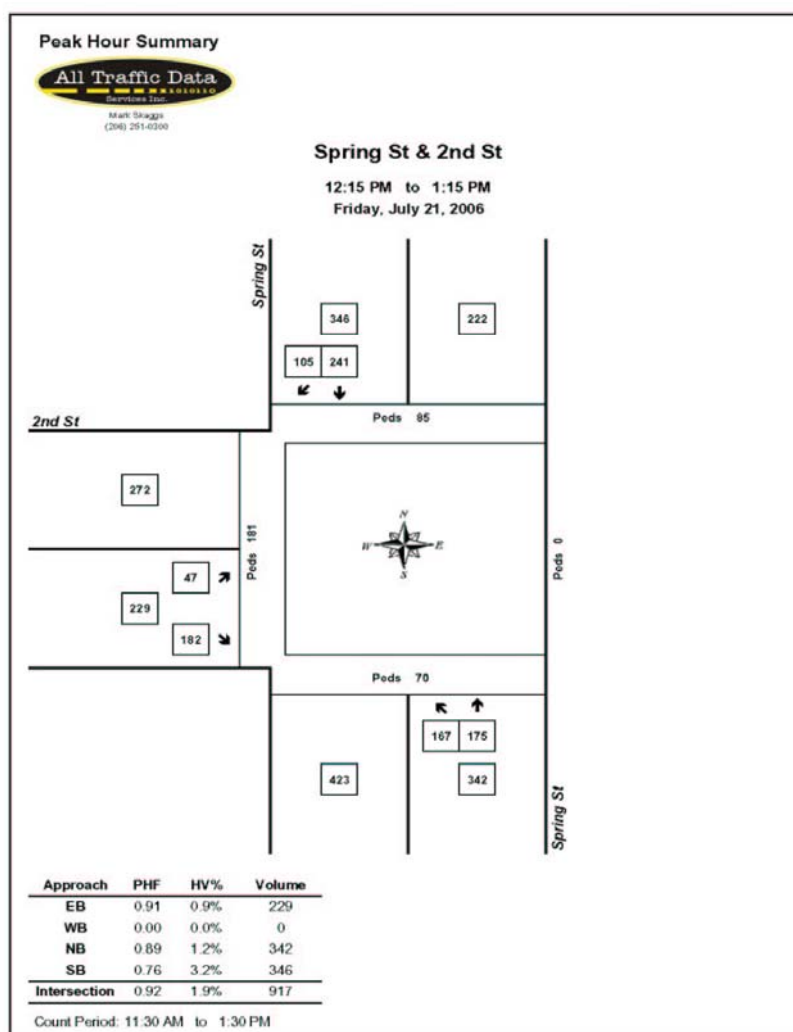


**Figure 16- Spring/First Turning Movements (Sunday 4:15 to 5:15 PM)**

### 5.1.2 Intersection of Spring Street and Second Street

Turning movement counts were collected at the intersection of Spring Street and Second Street on Friday July 21 from 11:30 AM to 1:30 PM and on Sunday, July 23 from 3:30 PM to 5:30 PM. There was no manual traffic control at that intersection.

Figure 17 provides the turning movement counts for the peak hour on Friday (12:15 PM to 1:15 PM).



**Figure 17- Spring/Second Turning Movements (Friday 12:15 PM to 1:15 PM)**

During the peak hour, the heaviest traffic volumes are observed on Spring Street, and the volumes are similar in the southbound and northbound direction (346 versus 342 vehicles). In the southbound direction, the proportion of right-turns from Spring to Second is 30%. In the northbound direction, the proportion of left-turns from Spring to Second is 49%.

Pedestrian crossings were higher across Second Street than across Spring Street. Across Spring Street, pedestrian crossings were higher on the north side of the intersection (85 crossings versus 70 on the south side). Volumes of pedestrian crossings across Spring Street are significantly lower than those observed at First Street.

The southbound movement counts on Spring Street include the ferry unloading traffic, which affected the intersection mostly between 12:30 PM and 1:00 PM. Between 12:30 PM and 1:00 PM, 227 vehicles were counted on the north leg of the intersection, coming from Spring and

First: 152 vehicles (67%) continued through on Spring Street, while 75 vehicles (33%) turned right onto Second Street.

Conflicting movements for the ferry unloading traffic include pedestrian crossings across Spring Street, northbound left-turns on Spring Street, and eastbound traffic on Second Street. Between 12:30 PM and 1:00 PM, counts on the conflicting movements were as follows:

- 42 pedestrian crossings on the north side of the intersection;
- 33 pedestrian crossings on the south side of the intersection;
- 73 vehicles turning left on Spring Street northbound;
- 110 vehicles on Second Street eastbound.

### 5.1.3 Turning Movements on Southbound Spring Street

Table 6 presents a comparison of turning movement volumes on southbound Spring Street at the intersections of First and Second Street.

**Table 6- Turning Movements on Southbound Spring St.**

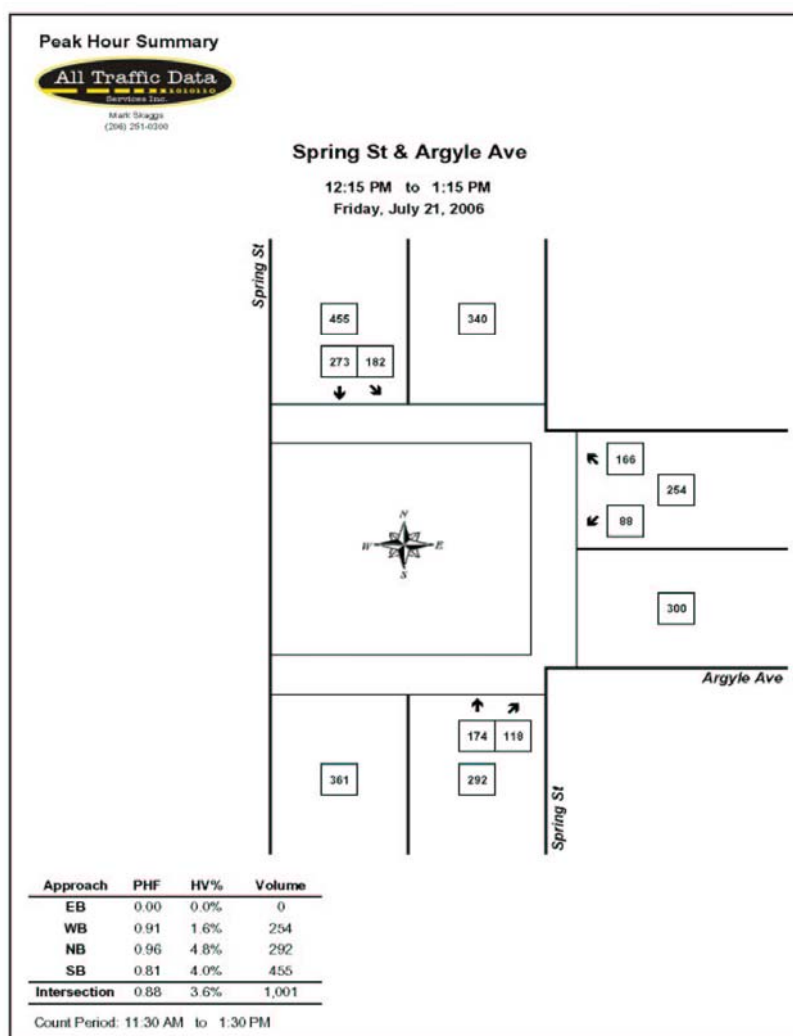
Day, Time & Location	30-minute Volumes (Ratio)			
	Right	Thru	Left	Total
<b>Friday 12:30 to 1:00 (Ferry Unloading)</b>				
Southbound Spring at First	36 (15%)	192 (80%)	11 (5%)	239
Southbound Spring at Second	75 (33%)	152 (67%)		227
<b>Sunday 4:30 to 5:00 (Ferry Unloading)</b>				
Southbound Spring at First	42 (16%)	198 (75%)	23 (9%)	263
Southbound Spring at Second	108 (44%)	137 (56%)		245
<b>Friday 11:30 to 12:00 (No Ferry Unloading)</b>				
Southbound Spring at First	20 (21%)	53 (55%)	24 (25%)	97
Southbound Spring at Second	23 (21%)	87 (79%)		110
<b>Sunday 3:30 to 4:00 (No Ferry Unloading)</b>				
Southbound Spring at First	11 (16%)	50 (71%)	9 (13%)	70
Southbound Spring at Second	35 (39%)	54 (61%)		89

The proportion of right turns is always higher at Second Street compared to First Street, under both ferry unloading and normal conditions. The proportion of right turns at First Street is

typically below 20%. The proportion to right turns at Second Street was observed to reach 44% during the unloading of the 4:15PM on Sunday.

#### 5.1.4 Intersection of Spring Street and Argyle Avenue

Turning movement counts were collected at the intersection of Spring Street and Argyle Avenue on Friday July 21 from 11:30 AM to 1:30 PM and on Sunday, July 23 from 3:30 PM to 5:30 PM. Figure 18 provides the turning movement counts for the peak hour on Friday (12:15 PM to 1:15 PM).



**Figure 18- Spring/Argyle Turning Movements (Friday 12:15 PM to 1:15 PM)**

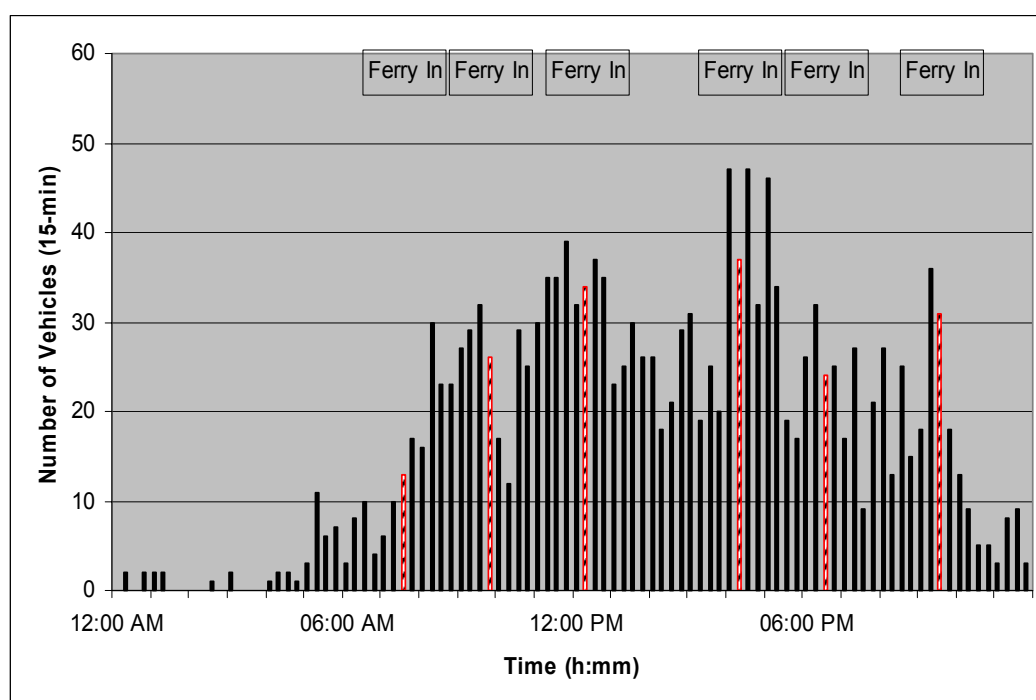
Counts at this intersection show a high level of left-turns from southbound Spring Street onto Argyle Avenue. During the peak hour on Friday, the proportion of southbound left-turns reached 40%.

## 5.2 Street Counts

The street count program provided mid-block traffic volumes at thirteen locations as shown on Figure 1. Counts were collected over three days (Friday, Saturday and Sunday) for 24 hours. The counts are typically aggregated over 15-minute periods. At the three locations closest to the ferry terminal (East Street, Front Street and Spring Street), volumes were also provided at 5-minute intervals. The following provides an analysis of some count results at key locations.

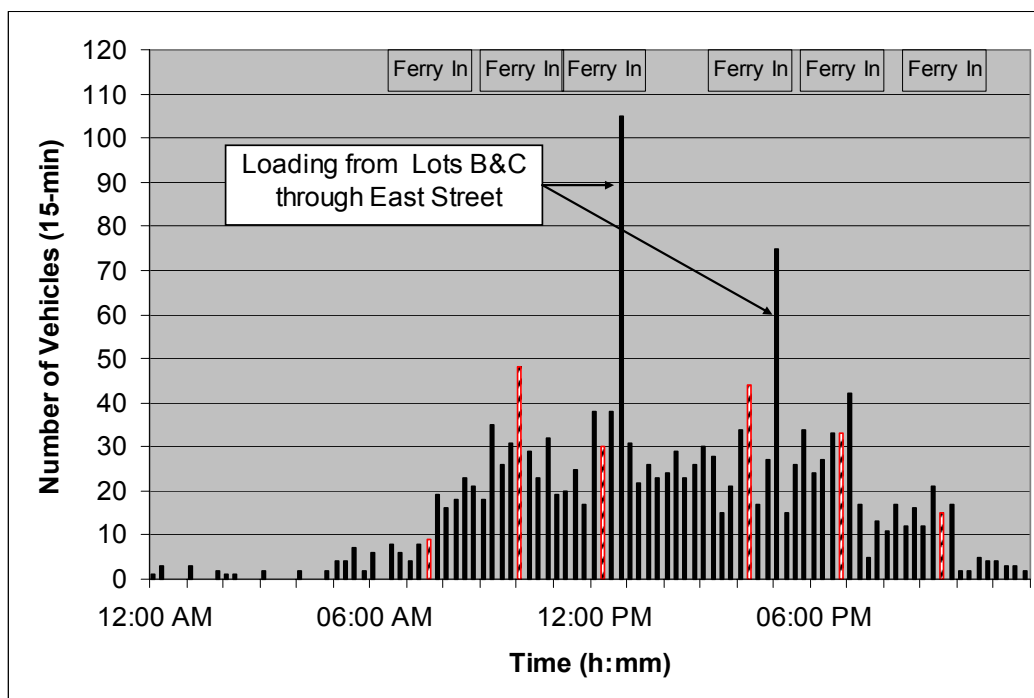
### 5.2.1 Counts on East Street between First Street and Front Street

Figures 19 and 20 present the results of the counts conducted on East Street, respectively for Friday (7/21) and Sunday (7/23).



**Figure 19- Traffic Volumes on East St. between First St. and Front St. (Friday)**

The traffic volumes observed on Friday are clearly influenced by ferry operations. Ferry arrivals (highlighted on the figure) consistently created an increase of traffic on East Street. The traffic increase was observed during approximately one hour before the ferry arrival and during off-loading. During the loading process, the traffic volume on East Street dropped to lower values. Highest peaks were observed at 4PM and 4:30PM with 15-minute counts of about 50 vehicles.



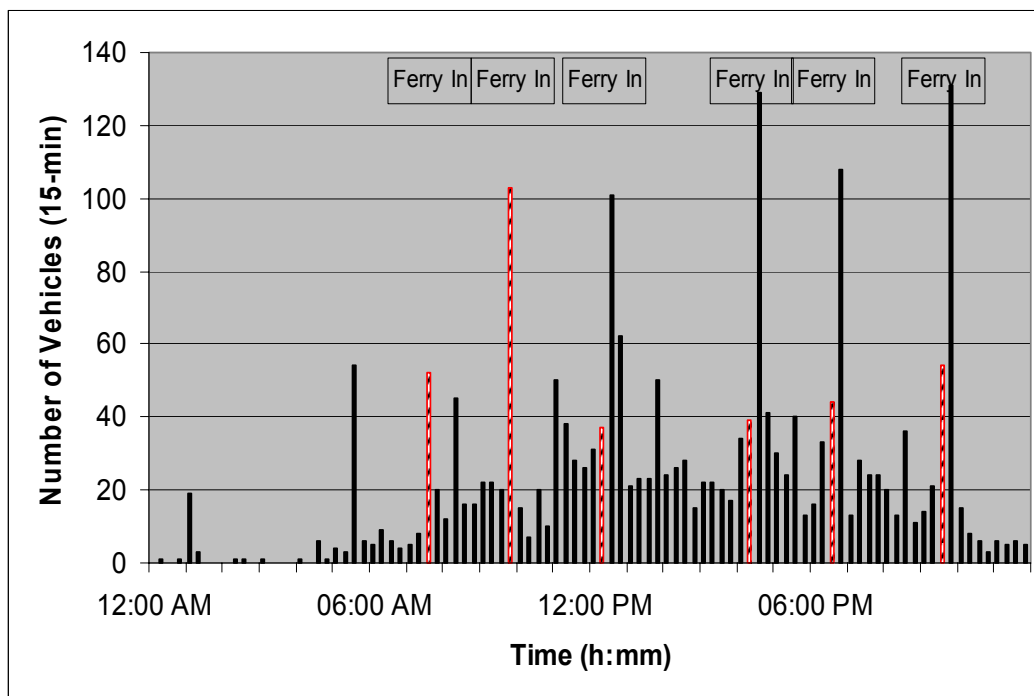
**Figure 20- Traffic Volumes on East St. between First St. and Front St. (Sunday)**

Traffic volumes on Sunday also show some peaks of about 40 vehicles per 15 minutes just before ferry arrivals. The much higher peaks observed at 12:45 PM and 5 PM correspond to the loading of vehicles from A Street, going down East Street towards the ferry dock.

### 5.2.2 *Counts on Front Street between the ferry dock and Spring Street*

Figure 21 presents the results of the counts conducted on Front Street for Friday (7/21). The time periods during which ferries arrived are highlighted on the graphic. As expected, the counts closely match the ferry schedule, with surges of traffic during the offloading process immediately following ferry arrivals. Volumes tend to be higher before ferry arrivals and lower after ferry loading. The background traffic is about 20 vehicles per 15 minutes, and is somewhat higher around noon (about 40 vehicles per 15 minute intervals).





**Figure 21- Traffic Volumes on Front St. between East St. and Spring St. (Friday)**

### 5.2.3 *Counts on Spring Street between Second Street and First Street*

Figure 22 presents the results of the counts conducted on Sunday (7/21) on northbound Spring Street between Second Street and First Street. Volumes are fairly constant from 8 AM to 7PM, averaging 60 vehicles per 15-minute intervals. Again, the time periods during which ferries arrived are highlighted on the graphic. There is no peak associated with ferry departures, indicating that vehicles tend to arrive over long periods.

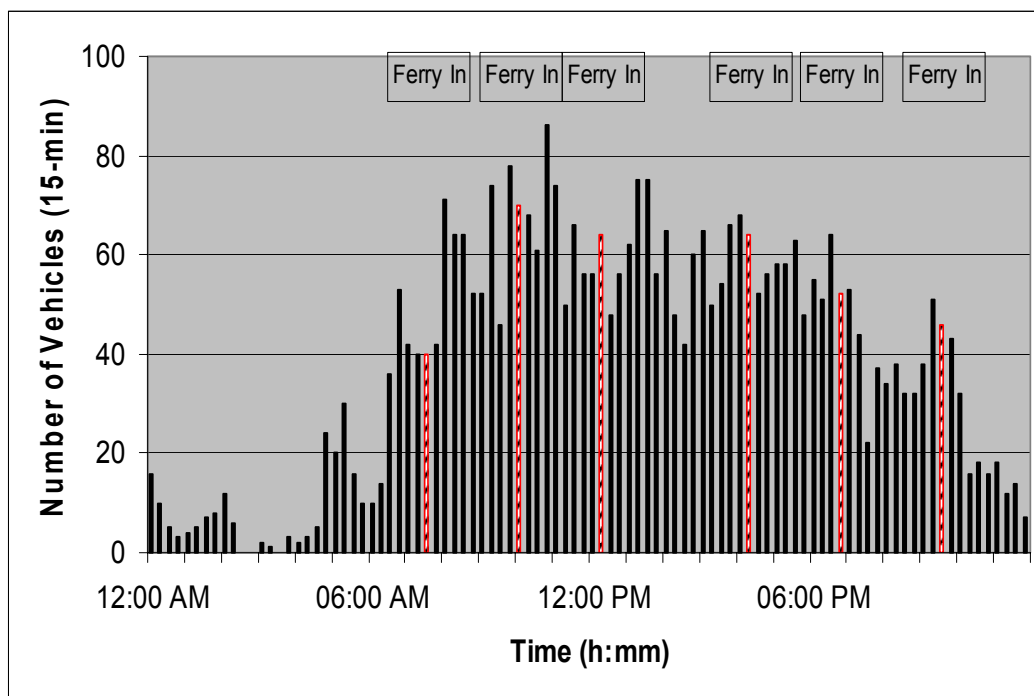


Figure 22- Traffic Volumes on Spring St. between Second St. and First St. (Sunday)